The Effect of Consistent and Inconsistent Punishment on the Exploratory Behavior of the White Rat

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TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS ii
LIST OF TABLES. v
LIST OF FIGURES vi

Chapter

I. INTRODUCTION. 1

- Purpose 1
- Related Literature. 3
- Summary of Related Literature 9
- Experimental Hypotheses 10
- Choice of Species 12

II. EXPERIMENTAL DESIGN 14

- Apperatus 14
- Subjects. 17
- Procedure 21
  - Differential treatment of groups on the punishment board. 23
  - Treatment of groups on the transfer board 24

III. RESULTS 26

- Treatment of the Data 26
- Early Versus Late Animals 26
- Comparison of Distances Covered on the Punishment Board. 28
- Comparison of Distances Covered on the Transfer Board. 29
- Comparison of Emotional Behavior on the Punishment Board. 32
- Comparison of Emotional Behavior on the Transfer Board. 33
- Additional Observations 34

Page

IV. INTERPRETATION AND CONCLUSIONS. 36

Discussion of Results 36
Implications for Further Research 39
Application of Findings 40
Summary and Conclusions 40

APPENDIX. 43

BIBLIOGRAPHY. 46

LIST OF TABLES

Table		Page
1.	Means and Standard Deviations for Distances Covered by Early and Late Groups .	27
2.	Significance of Differences between Distances Covered by Early and Late Groups.	27
3.	Comparison of Exploration on the Punishment Board	28
4.	Comparison of Trials to Criteria.	29
5.	Comparison of Exploration on the Transfer Board	31
6.	Comparison of Distances Covered on Trials 8 and 16 on the Transfer Board.	32
7.	Comparison of Defecation on the Punishment Board	33
8.	Comparison of Defecation on the Transfer Board	34
9.	Voltages Supplied to the Punishment Board .	45

LIST OF FIGURES

Figure Page

1. Punishment Board 15
2. Transfer Board 18
3. Data Sheet for Punishment Board. 19
4. Data Sheet for Transfer Board. 20
5. Exploration on Transfer Board. 30
6. Wiring Diagram for Punishment Board. 44

CHAPTER I

INTRODUCTION

Purpose

The purpose of this study is to discover the effect of consistent and inconsistent punishment on exploratory behavior. Exploratory behavior may be defined as that behavior which is motivated solely by an independent drive, the need to explore, and consists of movement, or wandering, about an open area. The independent variables in this experiment will be consistent and inconsistent punishment which will be used to train animals to restrict this behavior, and the dependent variable will be the effect of such training in a second situation.

Interest in this problem was motivated by frequent statements in the literature concerning the effect of consistent and inconsistent treatment on behavioral deviations in children. Many clinical psychologists, educators, and others agree that inconsistent punishment has a more detrimental effect on children's personalities and behavior than does consistent punishment. Books on child development provide us with the following statements:

> "Authority which is firm, kind, reasonable, and consistent gives the child the sense of security which is essential for his emotional development. . . . Discipline should be consistent. . . . Both parents (and grandparents) should be consistent in their behavior toward the child." (2, pp. 65, 67)

> "Inconsistency in the treatment of a child fosters intense anxiety and a weak ego organization. A child can build up adaptive patterns to or defenses against whatever treatment he receives, even when it is bad, if it is consistent.
>
> . . . .
>
> It is better for the child to know that he will be dealt with harshly than to be constantly on tenterhooks as to the kind of treatment he may receive. Both situations create anxiety, but of the two, the latter is the more serious." (18, p. 75)

> "Evidence is also tending to indicate that intensity of rewards and punishment is less important than the promptness and consistency of their occurrence, especially in the early periods of development of the child." (7, p. 626)

Agreement by authorities, however, or even apparent reasonableness of the conclusion that inconsistent punishment has a more detrimental effect on behavior than consistent punishment is not the equivalent of experimental evidence. Neither does such agreement describe the exact nature of the effect. Investigation of the literature discloses experiments that bear on the problem, but none that study it directly. The relevant studies come from many areas within the field of psychology. They do not lend themselves to easy categorization, but for the purpose of this study they have been grouped into: (a) studies of inconsistent treatment in learning; (b) studies of the behavioral effects of restriction of activity; (c) studies of the effect of punishment on learning; (d) studies of exploratory behavior; (e) studies of elimination as a measure of emotionality.

Related Literature

A. Studies of inconsistent treatment in learning. Probably the study most pertinent to the present experiment has been conducted by Aronov (1), who studied the effect of consistent and inconsistent guidance on human learning and transfer. Aronov, using a Warden U-type stylus maze, had students learn the maze under three different conditions. One group was provided with consistent and correct guidance; a second group was given incorrect and inconsistent guidance; and the third, a control group, was given no guidance. Following a fixed number of trials on the maze, all groups were then required to learn another maze, a mirror image of the first. The transfer effect of learning the first maze under varying conditions was measured in terms of the trials, errors, and time taken to learn the second maze.

Aronov found that those subjects who were given inconsistent guidance made significantly more errors and needed more trials to learn the transfer maze than did both of the other groups of subjects. Because of specific behavioral data and the effect of the experimental variables on individual subjects, Aronov concluded that the effect of inconsistent guidance is partly a result of the way in which the subject interprets the guidance, and that it has a detrimental effect on learning only when the individual is unable to rebel against or ignore the inconsistent guidance.

In studies of partial reinforcement, reward is provided only on some of the learning trials, the sequence of which frequently is randomly determined, thus providing us with conditions of consistent and inconsistent reward. It has been found that partial reinforcement is as effective in producing learning as complete reinforcement, and that habits acquired under partial reinforcement conditions are less subject to extinction (13).

B. Studies of the behavioral effects of restriction of activity. In the present study, punishment will be utilized to restrict activity. Previous studies have been conducted in which activity has been restricted, although such restriction has not always been enforced by punishment. Through the use of a case history method, Goldfarb (10) concluded that early institutional care resulted in a preponderance of passive, non-exploratory behavior during adolescence. Institutional care, we assume, has provided the child with a situation in which his exploration has been limited. This is probably true in terms of various behavioral kinds of exploration as well as geographic exploration. Of course, so many factors enter into the treatment of individual children in institutions that early restriction of activity, although it may be a contributory condition, cannot be designated as the primary factor which resulted in later non-exploratory behavior.

Baldwin (3) in an extensive study of nursery school children, reported that control and lack of democracy produces a "quiet, well-behaved, non-resistant child who is at the same time socially unaggressive and restricted in activity." Baldwin's term "lack of democracy" embraces a multitude of factors not readily controllable and prevents the study from being definitive in measuring the effect of control on behavior. Nevertheless, the study does provide further support for the conclusion that early restriction results in timidity and lack of exploration in later behavior.

Additional studies of the effect of restriction on activity have been conducted, the results of which are in essential agreement with the findings of Goldfarb and Baldwin. The behavior of dogs raised in home environments was compared with those raised in confining laboratory cages. The caged animals later displayed "freezing" behavior in a strange environment and showed restricted activity (8). We also must consider in evaluating this study that raising an animal in a home environment, in addition to providing more opportunities for exploration than a laboratory cage, also provides greater contact with humans.

A study of the effect of restriction which controlled the factor of human contact, although it did not provide punishment for violation of such restriction, was conducted by Patrick and Laughlin (17). They were concerned with the effect of raising rats in small and large cages, and found that the tendency of rats to explore a novel situation in adulthood is increased if they have been raised in large instead of small cages, again suggesting that restriction of early exploration results in reduced exploration in later unrestricted situations.

One apparent contradiction to this and to the above studies should be noted. Thompson and Heron (19), also using dogs, found that restriction of activity early in life is followed by increased exploratory activity. Manipulation of temporal factors, as well as differential treatment in the degree of human handling, may offer partial explanation for the apparent contradiction.

That human contact is a factor in animal behavior has been shown by Weiniger (20), who studied the behavior of previously "gentled" and "non-gentled" rats. His results suggest that rats who have been gentled in early life seem less timid and frightened in later situations and are more apt to remain in open unprotected areas.

C. Studies of the effect of punishment on learning. It has been demonstrated that punishment and the concomitant emotional state it arouses facilitate learning (13). Hilgard reports that Estes (12), utilizing intermittent punishment in extinguishing a conditioned response, found that intermittent punishment was more effective than punishment at every occurrence. This finding is in essential agreement with those on partial reinforcement.

D. Studies of exploratory behavior. In studying the effect of punishment on exploratory behavior it is helpful to assume that such behavior is aroused by a drive with characteristics that differentiate it from other drives.

That there is an exploratory drive has been demonstrated by a number of early studies (5), but most recently by Montgomery (14, 15). In his extensive work on exploration, he differentiated the exploratory drive from a general activity drive. On the basis of an experiment in which animals were permitted varying amounts of activity in early situations, he found no significant relationship between the amount of exploration in a simple maze and the amount of activity they were permitted in the early situations.

To establish further the unitary nature of the exploratory drive, he experimented with amount of exploration and found that as an area becomes more familiar to an animal (within one trial or on successive trials), exploratory activity decreases. Additionally, Montgomery has shown this phenomenon to have transfer characteristics. That is, rats who have had repeated opportunities for exploration explore less in situations similar to those in which they were originally permitted to explore, and the decrement shown in their exploration is positively correlated with the degree of similarity of the two situations.

E. Studies of elimination as a measure of emotionality.

A concomitant emotional state in restricted activity could well be fear, and a measure of fear might be a valuable indicator of the effect of punishment in this experiment. One measure that has been used as an index of fear or emotionality has been elimination, although the validity of this measure has not been clearly established.

An early experiment on elimination was conducted by Hall (11), who concluded that defecation and urination are measures of individual differences in emotionality. Bindra and Thompson (6), as a result of similar experiments, concluded that such tests give no evidence of a significant relationship between elimination and fearfulness. O'Kelly (16) obtained results similar to those of Bindra and Thompson.

Although the use of measures of elimination as an index of emotionality has only partial support, they were included in this study because in addition to their possible usefulness as an indicator of fear, it was hoped that as a result of this experiment, information might be provided which would assist in clarifying the use of such measures.

Summary of Related Literature

It has been noted in reviewing the literature that psychologists defend the position that inconsistent punishment has a detrimental effect on the behavior of children. The underlying supposition for their position is that a child will seek to discover and delineate clearly the limits placed on his behavior, and that failure to establish these limits will result in increased anxiety, fear, and timidity in later situations. One measure of fear and timidity is unwillingness to explore unfamiliar areas. Thus it can be hypothesized that children who have received inconsistent punishment, which has prevented them from establishing clear limits on their behavior, should act differently in a later situation than children who have received consistent punishment. It is this hypothesis which should be tested and which is not supported on the basis of available experimental evidence.

Studies related to this hypothesis have been conducted and help pave the way for a definitive study:

1. It has been suggested that inconsistent guidance has a detrimental effect on transfer of learning; and in terms of partial reinforcement, inconsistency seems to be as effective as consistency in reward learning situations.

2. Studies on the effect of early restricted environment suggest that it results later in reduced activity, with concomitant fear and timidity. However, in these studies punishment has not been adequately maintained as an independent variable.

3. Exploratory behavior has been isolated, and evidence of its resulting from a unitary drive has been provided, but no studies have been conducted which clearly indicate the effect of punishment on this drive or its behavioral manifestation.

Experimental Hypotheses

To measure the effect of consistent and inconsistent punishment on exploratory behavior, an experiment is needed which clearly provides a situation in which the exploratory drive is operative and in which the effect of consistent and inconsistent punishment on behavior instigated by this drive can be measured. The present experiment is designed to accomplish this end. One group of animals will be allowed free exploration. For another group, exploration will always result in punishment of the same intensity for the same amount of exploration; and a third group will find no regular relationship between the amount of their exploration and the presence or degree of punishment provided for such exploration. Both groups of punished animals will be trained until they inhibit their exploratory activity. They will then be permitted exploration in another situation. If punishment has any restricting effect at all, we should expect punished animals to explore less than those animals which were given no punishment for exploration. If inconsistent punishment has a more lasting effect than consistent punishment on exploratory behavior, then the amount of exploration should be further differentiated between groups, and the inconsistently punished animals should explore less in a transfer situation than animals that were punished consistently. Consequently, this experiment has been designed with the specific intention of testing the following hypotheses:

1. Rats which have been punished for exploration will explore less in a later transfer situation than rats which received no punishment for exploration.

2. Rats which have been punished inconsistently for exploration will explore less in a later transfer situation than rats which have been punished consistently for exploration.

Choice of Species

This chapter has made no distinction between studies that deal with humans and others that deal with animals. Certainly application of findings to our understanding of children would be more appropriate if children were used as subjects, but the rigorous specification of the type of exploration to be studied here and its experimental control, together with the type and systematic application of punishment, do not make the use of children feasible.

A basic assumption has therefore been made in conducting this experiment: Behavior is a phenomenon represented in all species and information disclosed from a study of one species has application in the understanding of another. The results of this experiment will, of course, have direct application only to an understanding of the behavior of rats; but it is because of the experimenter's interest in the possible application to children of principles investigated, that this study has been conducted.

Studies with the white rat, as a laboratory animal, have in the past contributed to our knowledge of human behavior sufficiently to justify their continued use in the investigation of psychological variables that are independent of the species in which they are studied. Argument for the use of animals to contribute to our understanding of people has been succinctly presented by Beach (4):

> "Just as animal research has proven useful in experimental surgery, pharmacology, and physiology, so can comparative studies in behavior contribute to the solution of problems confronting the psychiatrist. In the past attention has been focused primarily upon the study of deviant behavior in lower animals, and confirmation along these lines may increase our understanding of certain types of human behavior. In addition, recent excursions into the area of animal temperament and personality, the ontogenetic development of behavior patterns and the general physiological basis for behavior have yielded results justifying the optimistic prediction that future developments in these fields of animal research will be of increasing significance to those whose interest lies primarily in the field of human personality and its deviations."

CHAPTER II

EXPERIMENTAL DESIGN

Apparatus

Punishment board. The major piece of equipment utilized was the "punishment board" (see Fig. 1). This was constructed so that it provided a flat, circular surface six feet in diameter. Twenty-four concentric circles or tracks of copper sheeting, each one and seven-sixteenths inches wide, were fixed to the surface of the board and numbered in white paint consecutively from the center. There was a one-sixteenth inch space between tracks. The periphery of the board was surrounded by a fence fifteen inches high made of three sections of copper screening, each just under five inches wide, thus allowing a small space between sections.

The board was electrically wired from beneath so that a shock of increasing intensity could be delivered from the fifth track to the periphery, including the fence (see appendix, Fig. 6). Voltage was arranged so that close to the center the shock was just above threshold intensity, and at the periphery it was fairly severe but

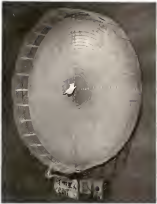


Fig. 1.--Punishment board

not sufficient to induce unconsciousness. A list of specific voltages can be found in Table 9 in the appendix. Note that the increase in shock, from the center outward, provides more intense punishment for relatively greater amounts of exploration.

In order to receive a shock it was necessary for the rat to contact any two, not necessarily adjacent, tracks from the fifth track outward, including the fence sections as additional tracks. In order to avoid receiving a shock, it was necessary for the rat to remain in the safe central area (approximately fifteen inches in diameter) composed of the first five tracks, or he could confine himself to any one track. No rat ever learned to use the latter method to avoid shock.

The above description refers to the basic wiring circuit. The switching arrangement was devised to permit shock to be delivered from the fifth track to the periphery, as described above, or only from the tenth, the fifteenth, or twentieth track to the periphery, allowing for a concomitant change in the size of the safe central area. Whenever shock was present at a particular track, its intensity was the same regardless of the size of the safe central area. By this arrangement, the punishment board could be used in such a way as to provide shock in four differently sized areas and could also be switched off so that no shock would be delivered anywhere on the board.

Transfer board. The second piece of equipment was a "transfer board" (see Fig. 2). This was made of wood, four feet square, with an unencumbered surface. At the periphery there was a border strip one inch wide and one-half inch high. The board was divided by pencil lines into sixty-four six-inch squares, and each square was numbered in white paint. The center of the board was the junction of squares 28, 29, 36, and 37.

Recording equipment. Mimeographed sheets carried a duplication of the pattern of the boards, including numbers of tracks and squares (see Figs. 3 and 4). A map-tracing device was utilized so that with carbon paper the device could be traced across the surface of the sheet duplicating the pattern of a particular animal. This provided an exact measure of the distance the animal covered, in addition to a permanent record of his exploration.

Subjects

Four groups of rats, 102 in all, were utilized and randomly assigned to the following groups:

Group	Number of Animals
Consistently Punished (C)	25
Consistent Control (CC)	25
Inconsistently Punished (I)	26
Inconsistent Control (IC)	26

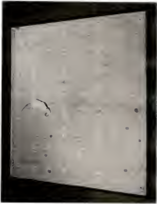
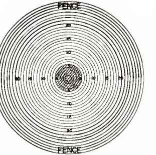


Fig. 2.--Transfer board

DATA SHEET EXPLORATION BOARD

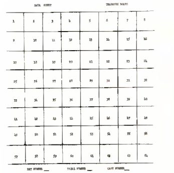


GROUP ___

RAT NUMBER ___ RAT IDENTIFICATION ___ INCHES TRAVERSED ___

TRIAL NUMBER ___ DEFECATION ___

Fig. 3.--Data sheet for punishment board



DATA SHEET TRANSFER BOARD

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

RAT NUMBER ___ TRIAL NUMBER ___ CAGE NUMBER ___

GROUP ___ IDENTIFICATION MARK ___ DISTANCE TRAVERSED ___

DEFECATION ___

Fig. 4.--Data sheet for transfer board

All animals were white male rats of the Charles River Sprague-Dawley strain, and all were 62 days old (plus or minus 3 days) at the time of their first run. So that litter controls would not be a problem in the experiment, each rat was obtained from a separate litter. The animals were housed approximately 6 to a cage, and each cage housed at least one but no more than 2 rats from each experimental group. Because of the difficulty in housing and running 102 animals at the same time, 60 animals were received and run as a first unit and approximately 43 days later, 42 animals were run as a second unit. In all cases the animals conformed to the same sex, age, and litter control specifications. All animals were received approximately 20 days prior to their participation in the experiment, so that each had a fixed and equal period of time to recover from any stress placed on him in transportation and to become familiar with his home cage. The animals were known to be experimentally naive, and any chance differences in behavioral experience prior to their acceptance for this experiment is assumed to be compensated for by their random assignment to groups.

Procedure

All animals were housed in a separate room adjoining the experimental room. All were placed on a demand supply of water and were fed approximately 10 grams of Purina Laboratory Chow twice daily so that they had completed eating shortly before they were run in the experiment. It was thus assumed that neither hunger nor thirst was present to act as motivating drives during the experiment.

The punishment board was placed in a room which was brightly illuminated in a fairly homogeneous manner. All animals, regardless of the experimental group from which they were obtained, were given two one-minute trials per day on this board under different conditions of shock. (An exception to this was the first trial of the 60 animals which arrived as the first unit and which received an initial trial of two minutes.) One trial was given in the morning and the other approximately ten hours later. They were run so that an animal from each experimental group was run in turn, and at no time did any animal's trial follow that of another animal from the same group. This insured that any practice effect of the experimenter's recording ability would affect all groups equally. A complete trial consisted of carrying the animal from his cage in the colony room, placing him in the center of the board, and permitting him th remain on the board for a period of one minute. He was then removed from whatever portion of the board he was on and returned to his living quarters.

The direction in which the animal faced when set in the center of the board on each trial, was randomized. Durby the time the rat remained on the board, the experimenter sat several feet away and kept a cartographic record of the pattern and extent of the animal's exploration with the map-tracing device. In addition, a record was kept of the number of boluses left by each animal, all previous excrement having been removed from the board.

Differential Treatment of Groups on the Punishment Board

Consistent group (Group C). These animals received a shock on every trial from the fifth track to the periphery. Each rat was run at the two one-minute trials per day rate until he met a criterion of four successive trials, during which he did not venture beyond the safe central area.

Consistent control group (Group CC). These animals were randomly matched to the consistent group so that for each consistent animal there was a consistent control animal. Each rat was given two one-minute trials a day with no shock delivered to the board, and each ran the same number of trials as his paired associate from the consistent group.

Inconsistent group (Group I). Inconsistently treated animals were given the two one-minute trials per day, with the location and appearance of shock randomized. Randomization was arranged so that the animal received one of five conditions randomly: He received shock from the fifth, tenth, fifteenth, or twentieth track to the periphery, or no shock at all. The order of appearance of any one condition was determined from a table of random numbers. These animals also were run until they remained within the safe central area for four consecutive trials. These tracks (one through five) always appeared on a safe area, although more frequently the safe area extended beyond this point for the inconsistently shocked group.

Inconsistent control group (Group IC). The animals of the inconsistent control group were matched randomly, animal for animal, with those of the inconsistent group, just as the consistent control animals were matched with those in the consistent group. They were permitted the two one-minute trials per day with no shock delivered to the board. Each rat was given the same number of trials as his paired associate from the inconsistent group.

Treatment of Groups on the Transfer Board

This board was also placed under bright illumination. Each animal was given two one-minute trials per day on the transfer board. He was placed in the center, allowed one minute of free, unpunished exploration, and then returned to his home cage. Again, the direction in which he faced when placed on the board was randomized from trial to trial. Each animal's trials on this board commenced twenty-four hours after his last criterial trial on the punishment board. To maintain this twenty-four-hour interval, if the criterion was reached in the evening, the animal received only one trial on his first day on the transfer board. All animals were permitted sixteen consecutive trials of unpunished exploration on the transfer board, regardless of his group affiliation or the number of trials he ran on the punishment board. The order of running the animals was again alternated so that no two animals who came from the same experimental group were run consecutively.

During the animal's trial on the transfer board, a cartographic record of his exploration was maintained, as well as a record of the number of boluses remaining on the board following the animal's trial. All excrement was removed from the board following each trial.

CHAPTER III

RESULTS

Treatment of the Data

Results were analyzed to test the hypotheses and to provide other information about the phenomenon in question. In all analyses Fisher's *t* (9) was utilized to determine the level of significance. Because the shock for the first trial of the early shipment of animals was of a higher intensity, the first trial on the punishment board was not considered in certain computations.

Distances were measured with the map-tracing device and are reported in units of that device. They are directly convertible to actual distances covered by the rats. However, since only relative distances are of concern in this study, the conversion was not made. To obtain actual distances covered, one must merely note that one unit on the measuring device is equal to one foot on the punishment board and to six inches on the transfer board.

Early Versus Late Animals

In order to determine the effect of any unknown differences between the early and late shipment of animals, *t*'s, based on distances covered, were computed between the two groups. Data for these comparisons are shown in Tables 1 and 2.

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR DISTANCES COVERED BY EARLY AND LATE GROUPS

Board	Early Shipment		Late Shipment	
	Mean	Standard Deviation	Mean	Standard Deviation
Punishment	161.25	139.73	127.51	145.27
Transfer	312.31	136.96	356.38	132.61

TABLE 2

SIGNIFICANCE OF DIFFERENCES BETWEEN DISTANCES COVERED BY EARLY AND LATE GROUPS

Board	*t*	Level of Significance
Punishment	1.1810	None
Transfer	1.6268	None

No significant differences were found between exploration of early and late groups. Therefore, results from animals in early and late shipments could be combined.

Comparison of Distances Covered on the Punishment Board

Results of the comparison of distances covered by the various groups on the punishment board are shown in Table 3. Differences significant at the 1% level of confidence were found between each experimental group and its control. When the experimental groups were compared with each other, no significant difference in amount of exploration nor in numbers of trials to criterion was found (see Table 4).

TABLE 3

COMPARISON OF EXPLORATION ON THE PUNISHMENT BOARD

Group	Mean	Standard Deviation	t	Level of Significance
CC	229.96	169.73	.3298	None
IC	245.38	157.49		
C*	78.04	82.44	3.4123	1%
CC*	209.72	170.16		
I*	74.46	63.50	2.9066	1%
IC*	228.77	151.90		
C*	78.04	82.44	.1706	None
I*	74.46	63.50		

*Trial 1 omitted.

TABLE 4

COMPARISON OF TRIALS TO CRITERIA

Group	Mean	Standard Deviation	*t*	Level of Significance
I	13.27	6.99	.3281	None
C	12.64	6.41		

The unequal numbers of trials run by each animal on the punishment board does not permit a graphic presentation of their exploration. The exploration of the control animals starts at a level slightly higher than that of the experimental animals and shows some slight reduction over a period of trials.

Comparison of Distances Covered on the Transfer Board

Comparison of distances covered for different groups on the transfer board is shown in Figure 5 and in Table 5. Again the control groups, CC and IC, did not differ significantly from each other. The C group explored significantly less than its control group, and the I group significantly less than its control. A comparison of the exploration of the C and I groups shows that the C group explored significantly more than the I group on the transfer board.

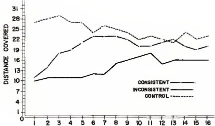


Fig. 5.--Exploration on transfer board

TABLE 5

COMPARISON OF EXPLORATION ON THE TRANSFER BOARD

Group	Mean	Standard Deviation	t	Level of Significance
CC	385.16	103.08	.6794	None
IC	406.31	114.25		
C	315.60	125.17	2.1015	5%
CC	385.16	103.08		
I	224.77	122.60	5.4175	1%
IC	406.31	114.25		
C	315.60	125.17	2.5651	2%
I	224.77	122.60		

A trial-by-trial comparison of the amounts of exploration on the transfer board is graphically represented in Fig. 5. Because distances covered on this board did not differ significantly between control groups, they are combined for presentation. Significance was tested between the C and I groups on trials 8 and 16, and the relative data are presented in Table 6. On trial 8 the Consistent group covered a significantly greater distance than the Inconsistent group. On trial 16 no significant difference was found between the exploration of the I and C groups.

TABLE 6

COMPARISON OF DISTANCES COVERED ON TRIALS 8 AND 16
ON THE TRANSFER BOARD

Trial	Group	Mean	Standard Deviation	t	Level of Significance
8	C	22.7	11.59	2.2699	5%
	I	15.3	11.32		
16	C	19.6	9.68	1.1972	None
	1	16.2	10.23		

Comparison of Emotional Behavior on the Punishment Board

As an indication of emotionality, the mean number of boluses was compared for all groups on the punishment board, data for which are shown in Table 7. Since no significant difference in defecation between the two control groups was shown, each experimental group was compared with its own control group. Although no significant difference was found between the defecation of the I and IC groups nor between the two experimental groups, the C group showed significantly more defecation than its control group, Group CC.

TABLE 7

COMPARISON OF DEFECATION ON THE PUNISHMENT BOARD

Group	Mean	Standard Deviation	t	Level of Significance
CC	9.08	9.79	.4529	None
IC	10.62	13.70		
C*	27.44	20.48	4.6814	1%
CC*	6.32	8.43		
I*	18.92	28.29	1.6966	None
IC*	8.35	13.00		
C*	27.48	20.48	1.2125	None
I*	18.92	28.29		

*Trial I omitted.

Comparison of Emotional Behavior on the Transfer Board

Data for a comparison of mean number of boluses for all groups on the transfer board are shown in Table 8. In this comparison, control groups did not differ significantly from each other. When the C group was compared with its control, no significant difference in defecation was found, although a comparison of defecation of the I group with its control disclosed a difference significant at the

5% level of confidence. Comparison of the defecation of experimental groups with each other disclosed no significant difference in defecation on the transfer board.

TABLE 8

COMPARISON OF DEFECATION ON THE TRANSFER BOARD

Group	Mean	Standard Deviation	*t*	Level of Significance
CC	9.36	16.96	1.1519	None
IC	5.19	6.32		
C	12.60	13.04	.7500	None
CC	9.36	16.96		
I	12.04	13.89	2.2459	5%
IC	5.19	6.32		
C	12.60	13.04	.1458	None
I	12.04	13.89		

Additional Observations

With the exception of three animals, all punished animals reached criterion. These three animals were continued until they had completed twenty-eight trials on the punishment board; not having learned by that time, their trials on the punishment board were discontinued. It is interesting to note that these animals were from the Inconsistent group.

A few animals leaped to the top of the fence in an attempt to climb over. These animals were pushed back onto the board for the remainder of their trials. Animals showed consistent preferences and individual ways of meeting the punishment situation; some animals seemed to be individually highly active, while others habitually showed very little activity.

Those animals that received punishment were harder to remove from their home cage, tended to stay toward the back of the cage away from the experimenter when other animals were removed, and displayed trembling and a definite unwillingness to leave the experimenter's hand when placed in the center of the punishment board. On the two occasions that the experimenter was bitten, it was by animals who were punished. However, no quantitative measures of these behavioral differences were made.

CHAPTER IV

INTERPRETATION AND CONCLUSIONS

Discussion of Results

A. Exploration on the transfer board. On the basis of results obtained our first hypothesis was substantiated, namely, that rats which have been punished for exploration do explore less in a later transfer situation than rats which have received no punishment for exploration. While the control groups did not differ significantly from each other in distance covered on the transfer board, the C group explored significantly less than their controls at the 5% level of confidence, and the I group explored significantly less than their controls at the 1% level of confidence.

Results also fully support our second hypothesis: Rats which have been punished inconsistently for exploration explore less in a later transfer situation than rats which have been punished consistently for exploration. The C and I groups differed significantly in mean units covered on the transfer board at the 2% level of confidence. This was even more significant than the difference between the C group and their controls (significant at the 5% level of confidence).

A comparison of the exploration of these groups on the transfer board is obtained by again noting Fig. 5. The consistently treated group shows quick recovery from the effect of punishment. Although the C and I groups show no difference in exploration when first placed on the transfer board, we note that the curve of the Consistent group shows a sharp rise and soon differs markedly from the I group. This difference is still significant at trial number 8. By trial number 16 there is still a tendency for the three groups of animals to maintain their separation, with the control animals showing most exploration, the C group next, and the I group, least exploration. However, the differences at this trial are not significant. Thus, in terms of restriction of exploration, inconsistent punishment has longer-lasting effects than consistent punishment.

B. Exploration on the punishment board. Additional data show that conditions of punishment resulted in a differential degree of exploration in the learning situation only between punished and unpunished animals; it did not differentiate between the consistently and inconsistently punished groups. There was also no significant difference in number of trials necessary to reach criterion between the consistently and inconsistently treated groups.

C. Exploration as an independent drive. Noting Fig. 5 we find evidence to support Montgomery's contention that exploration has the drive characteristic of satiability. Control animals which received no punishment tended to explore less on successive trials. This was evidenced in their performance on both the punishment and transfer boards.

D. Elimination as a measure of emotionality. If elimination is a measure of emotionality, our results on the punishment board may be difficult to explain. We note that the only significant difference in amount of defecation was between the C group and its control (Group CC). Does this mean that under conditions of consistent punishment emotionality is manifested, while under conditions of inconsistent punishment, it is not? It would seem more logical to interpret these results as further evidence of the unreliability of using elimination as a measure of emotionality.

On the transfer board we find that the only significant difference in amount of defecation was between the inconsistently punished animals and their controls (Groups I and IC). Although one might say this is evidence of the emotional state of the I group which was no longer present in the C group, the unusual differentiation shown in measures of elimination permits us to say only that elimination probably cannot be relied upon as a measure of emotionality.

Implications for Further Research

This experiment suggests a number of follow-up studies to provide further information about the effects of consistent and inconsistent punishment. Additional studies might be undertaken to answer the following questions:

1. What is the effect of varying the age at which differential training takes place?

2. What would be the effect of providing a different time interval between learning and transfer trials?

3. What are the limits of the transfer effect? How dissimilar can a transfer situation be from the learning situation and still differentiate the conditions of learning?

4. Does inconsistent punishment have a systematic effect on behavior other than exploration; i.e., feeding, aggression, weight, intelligence?

5. Would there be any social effect if animals which were trained under different conditions of punishment were paired for their trials on the transfer board? Would more frightened animals influence the animals which show little fear, or could the influence be in the opposite direction?

Application of Findings

It has been shown that different conditions of punishment in one situation can affect the behavior of animals in a situation that is different from the one in which the punishment was originally applied. The results can be rigidly applied only to an understanding of the behavior of rats. However, speculation regarding the application of the findings of this experiment to an understanding of the exploratory behavior of children provides us with interesting and challenging possibilities. In addition to providing further evidence of the effect of inconsistent punishment, it points out the differential effect between consistent and inconsistent punishment. If the findings on the effect of punishment also have application to our understanding of children, then we might speculate that while inconsistency has a more lasting effect on their behavior, its effect is not immediately shown in the learning situation, but is demonstrated in a later situation that differs from the one in which the learning took place. Further experimentation might disclose how dissimilar a situation can be from the original learning situation and still show the effects of differential forms of punishment.

Summary and Conclusions

The present study was designed to measure the effect of consistent and inconsistent punishment on exploratory behavior. It was hypothesized that punishment would result in fear and timidity which would restrict activity, and that inconsistent punishment would have a more detrimental effect on exploration than consistent punishment.

The major piece of equipment utilized was a punishment board, electrically wired so that a shock of increasing intensity could be given for greater exploration. Rats could avoid shock by remaining in the safe central area, which was always at least fifteen inches in diameter. Wiring also provided the differential application of shock from the tenth, fifteenth, and twentieth tracks to the periphery, including the fence. The second piece of equipment was a square transfer board upon which was pencilled a grid-like pattern.

Recording equipment took the form of mimeographed sheets duplicating the pattern of the boards, and a map-tracing device. This provided a permanent record of the distance traversed by each animal.

One hundred two male rats of the Charles River Sprague-Dawley strain, 62 days old at the time of the experiment, were used. Animals were randomly assigned to four different groups: A consistently punished group, an inconsistently punished group and two control groups, each made up of approximately 25 animals.

Animals were housed six to a cage and provided with adequate food and water so as to prevent hunger or thirst from acting as activating drives in the experiment.

On the punishment board all animals received two one-minute trials per day under different conditions: Consistently punished animals received a shock on every trial, inconsistently punished animals were shocked in a random manner.

Twenty-four hours after their final trial on the punishment board, each animal commenced trials on the transfer board. As with the punishment board, each animal was permitted two one-minute trials daily. All animals regardless of group affiliation were run a total of sixteen trials on the transfer board.

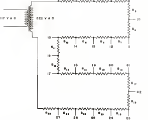
Specifically, the experiment was designed to test the following hypotheses:

1. Rats which have been punished for exploration will explore less in a later transfer situation than rats which received no punishment for exploration.

2. Rats which have been punished inconsistently for exploration will explore less in a later transfer situation than rats which have been punished consistently for exploration.

Results of the experiment substantiated both hypotheses.

APPENDIX



NOTES

1 NUMBERS CORRESPOND TO TRACK NUMBERS.

2. RESISTANCE VALUES

R_1 - 200 Ω ½ W
R_2 - 200 Ω ½ W
R_3 - 250 Ω ½ W
R_4 - 365 Ω ¼ W
R_5 - 540 Ω ¼ W
R_6 - 400 Ω ¼ W

R_7 - 376 Ω ½ W
R_8 - 460 Ω 1 W
R_9 - 560 Ω 1 W
R_{10} - 540 Ω 1 W
R_{11} - 605 Ω 1 W
R_{12} - 665 Ω 1 W

R_{13} - 660 Ω 1 W
R_{14} - 730 Ω 2 W
R_{15} - 745 Ω 2 W
R_{16} - 765 Ω 2 W
R_{17} - 860 Ω 2 W
R_{18} - 960 Ω 2 W

R_{19} - 865 Ω 2 W
R_{20} - 905 Ω 2 W
R_{21} - 945 Ω 2 W
R_{22} - 1000 Ω 2 W
R_{23} - 1065 Ω 2 W

Fig. 6.--Wiring diagram for punishment board

TABLE 9

VOLTAGES SUPPLIED TO THE PUNISHMENT BOARD

Track Numbers	Voltage
5-6	7.2
6-7	7.5
7-8	8.7
8-9	10.9
9-10	12.
10-11	13.8
11-12	13.3
12-13	17.
13-14	20.1
14-15	28.
15-16	22.4
16-17	24.1
17-18	25.2
18-19	27.
19-20	27.3
20-21	27.9
21-22	31.1
22-23	31.1
23-24	32.8
24-25	32.9
25-26	34.7
26-27	36.7
27-28	38.8

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BIOGRAPHICAL ITEMS

The writer was born in New York City on April 18, 1925. He graduated from Christopher Columbus High School, Bronx, New York in 1943. From 1947 to 1950 he attended Adelphi College and received the Bachelor of Science Degree (Psychology). He received the Master of Science Degree from City College of New York, which he attended from 1950 to 1951, majoring in Psychological Services. In June 1953 he entered the University of Florida to continue his graduate studies in psychology.

From 1943 to 1946 the writer served in the United States Army Air Force. In the Air Force he became a commissioned officer and served as aerial navigator. From 1951 to 1953 he was staff psychologist at Highland Hospital, Asheville, North Carolina. Since his entry in the University of Florida he has served as student assistant, graduate assistant, and clinician in the Psychological Clinic. He is currently an assistant in research at the J. Hillis Miller Health Center of the University of Florida, an appointment he accepted in September 1956.

The writer is a member of the American Psychological Association, the Southeastern Psychological Association, and the Florida Psychological Association for which he is serving as Secretary of the Standards and Ethics Committee.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June 3, 1957

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